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ESKRIDGE (J.T.)

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SYMPTOMS OF SPEECH* DISTURBANCES AS AIDS
IN CEREBRAL LOCALIZATION.

BY J. T. ESKRIDGE, M.D.,

DENVER, COL.,

Neurologist to the Arapahoe County and St. Luke's Hospitals.

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By J. T. ESKRIDGE, M.D.,

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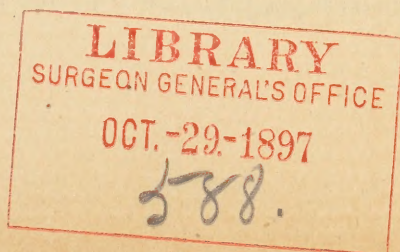
SPEECH and language, for language is more than speech, are so intimately connected with the various functions of the brain that only lesions giving rise to certain definite disorders of speech can be accurately localized. There are probably numerous cortical centres for speech memories, but at present not more than five of these are localizable.

For practical purposes of cerebral localization, it matters not whether we accept the theory advocated by Freud¹ that the speech apparatus is found located in an unbroken area of the cortex in the left hemisphere, between the cortical endings of the auditory and optic nerves, and the motor speech and arm fibres, or the views held by many able investigators that in certain portions of this cortical area are found a number of definite speech centres connected with one another by sub- and transcortical fibres, the fact still remains that disturbance of definite portions of the brain gives rise, when uncomplicated by other conditions, to distinct and unvarying disorders of speech.

The higher, differentiated forms of speech are unilaterally located in the brain, in the left cerebral hemisphere in right-handed persons, and in the right hemisphere in left-handed individuals, yet, as Hughlings-Jackson first pointed out, motor speech, at least, is bilaterally represented in the brain. A person may be speechless from a unilateral lesion, but this rarely renders him wordless. That is, he may be unable to utter speech, yet he may understand the speech of another.

Motor Speech Centres.—Motor or emissive speech centres seem to be confined to a small area of the cortex, the feet of the second

¹ Zur Auffassung der Aphasien, 1891.



and third frontal, and the extreme lower portions of the central (ascending frontal and parietal) convolutions. While this entire area is small, yet in it there appear to be three centres concerned in motor-speech mechanism. They occupy such a small portion of the cortex and are separated by such a small space that it is rare to have one involved by a gross lesion without having the others affected. A few clinical cases, however, are on record that seem to demonstrate that one of these centres may be rendered functionless and the others left intact, or impaired to a slight extent.

The first of these centres is the only motor centre of speech that has received general recognition, and in honor of its discoverer, it is usually known as Broca's centre of speech. It is situated in the foot of the third left frontal convolution in right-handed persons and in the corresponding portion of the opposite hemisphere in left-handed individuals.

If the lesion is strictly limited to this portion of the cortex, but more or less completely destroys the centre, the patient will be unable to speak voluntarily, to repeat words after another, to read aloud, to think in words, and in the majority of instances to write voluntarily or from dictation so as to be understood, but he will be able to understand speech, at times printing and writing, and he may be able to write from copy, transcribing writing and printing into script. If the wrong word is uttered he is aware of it, although he may be unable to correct his mistake. This is the usual form of motor aphasia, but the lesion is rarely confined to Broca's convolution, besides, in the majority of cases of this form of speech defect, the connections of this centre with other centres of speech are affected. This results in

Combined Motor Aphasia.—The most common form of motor aphasia is where all the cortical motor centres of speech are invaded by a lesion, either directly by partial destruction of all these cortical centres, or indirectly by the invasion of the commissural fibres that connect them. In such cases, if the lesion is sufficiently extensive or situated so as to affect the fibres from the motor speech centres to the corpus callosum, the aphasia will be permanent. The patient may be speechless, not able to utter a single word or intelligent sound, although he is rarely wordless, as he can understand the speech of another.¹ While at first the patient may not be able to utter a single word voluntarily, oaths, interjections of surprise and delight, expressions indicating anger, etc., may be uttered suddenly if the oro-lingual centre is not seriously involved. If the patient attempts to repeat these expressions voluntarily, he will fail. Gesture or pan-

¹ Hughlings-Jackson.

tomime expression next to emotional speech is best retained, although this is often greatly impaired at first. If the lesion has invaded the foot of the second frontal convolution the patient will be unable to write voluntarily or at dictation, but it is possible that he may be able to copy if the muscles used in writing are not paralyzed. In all forms of uncomplicated motor aphasia due to a cortical lesion, if the patient is able to write from copy he will transcribe both printing and writing into script; while most sensory aphasiacs, on the other hand, will copy mechanically each letter just as it appears to them; thus, writing will be copied into script and printing will be slowly and laboriously printed, each letter receiving the same degree of shading found in the original. Professor Dejerine believes that these methods of copying are invariably followed out by the motor and sensory aphasiacs.¹ I am willing to admit that this is true of the motor aphasiac, but I fear there are exceptions to the usual method of copying printing by the sensory aphasiac. It is well to bear in mind that gesture expression is sometimes lost in sensory aphasia, as well as in rare cases of the motor variety.

Dysarthria from Oro-Lingual Paresis or Paralysis.—This is the second form of motor aphasia to which I wish to direct attention. It may be questioned whether this should be considered under the heading of aphasia. As this defect of speech is attended with different symptoms from what we find in difficult or disjointed articulation from a lesion occurring in the pons or medulla, it seems to me best to consider it as one of the forms of motor aphasia. The cortical centre for the movement of the muscles concerned in speech is located in the lower portions of both central convolutions. In the cases of this kind heretofore recorded, the tongue and lip muscles have been the principal ones to suffer, and those of the larynx have escaped to a much greater extent. Mills² refers to an interesting case observed by himself in which the lesion involved the lower portions of both central convolutions on the left side, the foot of the third frontal escaping almost entirely. Articulation was imperfect, but the patient could talk and propositionize.

In the *Medical News* for August 15, 1896, I have recorded a case of speech defect due to oro-lingual paralysis, and I copy the following from the report: "On thoroughly and systematically testing his power of speech, no form of sensory aphasia is detected. He understands printed and written words. He reads inaudibly and compre-

¹ Professor Dejerine, Sensory Aphasia, *International Medical Magazine*, August, 1895, pp. 524-528.

² A Text-Book on Nervous Diseases, by American Authors. Edited by Dercum, pp. 409-410.

hends what he reads. On reading aloud his articulation is so imperfect that it is impossible for the listener to understand what he reads, except a simple word occasionally, which by an explosive effort of the lips the patient pronounces distinctly enough to be understood, if one is paying close attention. He can write voluntarily, at dictation, and copy, but he never learned to write well, and he forms the letters very imperfectly with the left hand. (His right hand is partially paralyzed.) He can write a little with the right hand. He copies printing and writing into script. When asked if he understands what he reads he nods his head, and with an explosive movement of the lips says, 'Yes.' He repeats simple words after another. It is observed that the greater the effort that he makes to pronounce a word, the more nearly he succeeds in pronouncing it distinctly, thus differing from the defect in speech due to a lesion in Broca's convolution, in which 'reflex' or 'automatic' speech is preserved to a greater extent than voluntary speech. As well as can be determined, he has no difficulty in thinking in speech, propositionizing."

As the diagnosis was a little uncertain as to whether the lesion was a tumor or thrombotic softening, I recommended trephining over the extreme lower portion of the fissure of Rolando. Dr. E. J. A. Rogers operated; found the lower portion of the ascending frontal and parietal convolutions softened and broken down. The degenerated portion of the cortex was removed. No lesion was found to account for the weakness in the right arm and leg.

On May 4, 1896, four months after the operation, the patient manifested marked improvement. The right leg was used nearly as well as the left; the right arm was only slightly weaker than the left, but it showed some ataxia, especially for finer movements, such as writing, etc. The right side of the face was wasted, especially around the corner of the mouth, and the face was drawn a little to the right. The speech defect was of the same character as found before the operation, but it was much less marked. With a decided effort he could slowly and deliberately pronounce most words, even those of considerable length. Sometimes it required two or three attempts to pronounce a long word, but in the end he usually succeeded. The lips and tongue were not paralyzed but ataxic. They presented very much the same condition that was found in the muscles of the right hand and arm. He had no difficulty in thinking in speech. He still wrote much worse with the right hand than he had done before his sickness. The writing with the left hand was fairly good for one who never wrote even an ordinary hand. He did not transpose any letters. Simple words he spelled and wrote correctly. If a word were spelled for him he did not write it any more rapidly or correctly

than when he was allowed to spell it himself. The defect in writing seemed to be due entirely to the ataxic condition of his right hand and arm.

The patient died a few months subsequently from acute softening of one side of the pons, caused by thrombotic occlusion of an artery. At the autopsy the insula and the third frontal convolution were normal in appearance; the cortical softening had been limited to the lower portions of the central convolutions; neither the arm nor leg centres of the cortex showed any change. In the left lenticular muscles, extending from a point opposite the knee of the internal capsule backward, softened areas presenting a cystic appearance were found. The front part of the softening was some distance external to the internal capsule, but the posterior portion reached up to the capsule. It seemed quite evident that the cortical lesion alone accounted for the oro-lingual paresis, and the lenticular lesion for the weakened and ataxic condition of the arm and leg.

In connection with the publication of this case I have said, "Kussmaul and others give muscular wasting of the face in connection with speech defect as one of the diagnostic symptoms of bulbar lesion in contradistinction to one occurring above the nuclei of origin of the cranial nerves concerned in articulation and phonation. But few writers so far have laid stress upon the fact that an irritative cortical lesion may cause rapid and pronounced wasting in the group of muscles involved. The second case reported in this series is a striking example of this.¹ One of the chief symptoms between atrophy of the muscles from a nuclear lesion and from one in the cortex is that in the latter the affected muscles respond normally to electricity, while in the former they do not. The wasting from irritative cortical lesion is probably due to an inhibitory influence on the trophic centres, while that which occurs from a nuclear lesion is due to the direct effect on the trophic centres of the muscles themselves. In a case of oro-lingual paralysis or paresis, when the lesion is on the left side, articulation will be imperfect, but many words may be uttered so as to be understood. There will be no defect in thinking, in speech propositionizing, provided Broca's centre is intact. The greater the effort exerted by the patient in pronouncing a word the more nearly he will succeed. In aphasia due to a lesion in the third left frontal convolution, the greater the effort made by the patient in uttering a word, the more signally the failure.² He will speak best when he surprises the muscles concerned in articulation, and in consequence automatic or reflex speech may be preserved

¹ Medical News, July 11, 1896, p. 120.

² Ibid., August 15, 1896, p. 179.

when voluntary speech is lost. Broca's centre is unilateral and situated on the left side in right-handed persons and on the right side in left-handed individuals. On the other hand, the oro-lingual centre is bilateral, and destruction of the left centre will not abolish the ability to talk; there will be a dysarthria rather than an anarthria. As the centre is so close to the one presiding over the muscles concerned in writing, any defect in writing will be a dysgraphia rather than an agraphia. There will be no transposition or omission of letters or words, nor misspelling. In a paralyzing, non-irritating cortical lesion the tongue would probably deviate towards the affected side of the face, and the muscles of the lower side of the face will be very weak but not completely paralyzed, and those of the upper side of the face will act less readily and more imperfectly than in the normal condition. When the cortical lesion is an irritative but paralyzing one, as occurred in the case reported by me, the tongue may be protruded in the median line, but there will likely be some deviation if it is kept protruded for some minutes. The affected muscles of the lower side of the face will be wasted to a greater or less extent."

At the time of reporting this case I had not met with one in which the lesion was in the right oro-lingual centre. A few weeks ago, however, Dr. Parkhill referred a patient to me with a lesion in the lower portion of the right central convolution, of thirty-four years' duration. The symptoms, so far as speech defect was concerned, were strikingly similar to those observed in the case in which the lesion was on the left side. This case will be reported by Dr. Parkhill and myself in a joint paper.

Anorthographia.—While motor agraphia has been recognized by nearly all systematic writers on aphasia, yet very few are inclined to the view that there is a graphic centre distinct from that which controls the muscles of the hand and arm concerned in writing. Most cases of motor agraphia have occurred in connection with a lesion in the foot of the third frontal convolution. Many, however, are of the opinion that in the foot of the left second frontal convolution, which is just in front of the centre for the movements of the hand, is situated a centre, the relation of which to writing is similar to that of Broca's centre with reference to speech utterance. In regard to this Mills¹ says that "no clinico-pathological case fully corroborative of this statement has been put on record."

Quite recently I reported a case of cyst of the brain in the foot of the left second frontal convolution, in which there was an inability to write on account of loss of the power to spell or to arrange letters in words according to common usage. Every letter in the alphabet

¹ A Text-Book on Nervous Diseases, by American Authors, p. 436.

was well formed, and the patient wrote a good legible hand when the words were spelled for him.¹ The case is extremely interesting. I will give the principal points from the detailed report in which copies of specimens of the patient's writing will be found.

A man, a stock-raiser by occupation for the last few years, strong and rugged in appearance, but subject to frequent attacks of migraine, wrote a good and rapid hand. In September, 1893, he first experienced difficulty in writing. He misspelled and transposed the letters of the words. The disturbance soon became so great that it was difficult to make any sense out of what he had written. Scarcely a word of any length was spelled correctly a year after he first experienced difficulty in writing. He soon ceased to write, as the effort was tiresome to him, and he had to spend an hour or more in trying to write a page of note-paper. In July, 1894, the patient began to suffer from pain in the frontal region of the head. In January, 1895, the patient, while conversing with his wife, suddenly found himself unable to talk for a period of about fifteen minutes. He could not utter a single articulate sound. His mind, he said afterwards, was perfectly clear at the time. On April 19, 1895, at the time that he first consulted me, muscular power and all forms of sensation were normal. Mental action was very defective in concentration, sustained attention, and in memory. There was no form of visual or auditory defect in speech. He could speak voluntarily, but speech was slow, and he occasionally hesitated in pronouncing long words. He repeated words after another quite readily, except that he was slow and deliberate in articulating, and sometimes he hesitated before trying to pronounce some words. It was observed that the greater the effort that he made in trying to utter words, the more nearly he succeeded. If he made a mistake he at once recognized it and usually corrected it. He wrote his name well and copied printing and writing into script with scarcely a mistake. In writing voluntarily he transposed the letters of words, and added, omitted, and transposed letters, and sometimes words, so that it was difficult to make any sense out of what he wrote, unless one knew what he was trying to write. On asking him to spell a number of words that he had written, it was found that he made the same mistakes in spelling by ear that he had made in writing. It seemed to matter little how he spelled a word, he usually pronounced it correctly.

On October 24, 1895, about six months after I had seen him, I again examined him. I found that he was partially demented, he had lost in weight, suffered severely from headache, but the only pronounced symptom was the inability to write intelligibly on account

¹ Medical News, August 1, 1896, p. 122.

of his inability to spell. This was more pronounced than at the time of the first examination. I had the patient write me a letter each day for a period of about six weeks, giving me his own biography. He copied both printing and writing into script, and wrote much more rapidly at this than he did at dictation or voluntarily. If I spelled the words for him he wrote readily and made no mistakes. It took him about two or three hours to write voluntarily a letter containing six or seven lines.

I decided to recommend an operation for the removal of a growth from the foot of the second left frontal convolution. December 5 was the day set for the operation. On December 2 he wrote the following letter:

"Dec. 2, 1895.

"DR. ESKRIDGE.

"Drar Ser

"I wont too sells three Hudderd acers of lande foe actage six Rooms rick and Saliage Hous Mtht Barnis and shedes and a Poller yard close In Denver. I am a goact palie men, and the is Lore our loge and two derery ccows.

"and I wanie teal you Ediths preare whe she gose two Boan when I lve awn ton I prey the cook Lorde my slir tow seope and my papa and my momo and Edith.

"the Fanlure thatewdeEct note we did nonte tale cin.

"Dence

tal Cannede

"a untill go tow SickKes Hospreal."

Knowing what he wanted to write, the letter may be liberally translated thus:

"December 2, 1895.

"DR. ESKRIDGE:

"DEAR SIR,—I want to sell three hundred acres of land for a house, a six-room brick cottage, with barns, sheds, and poultry yard, close to Denver. I am a good poultry man. We have four cows—two large and two small dairy cows. I want to tell you Edith's prayer, which she says when she goes to bed, 'When I lay me down to sleep, I pray the good Lord my soul to keep, and my papa, and my mamma, and Edith, and whom I love as my own soul.' The furniture that we do not want in Denver I wish to sell. Continued until I go to St. Luke's Hospital."

On the day set for the operation Dr. Clayton Parkhill trephined over the foot of the left second frontal convolution, found a cyst and evacuated its contents. No other pathological changes in the brain were found.

After the operation his mental condition considerably improved, and he wrote much better, making fewer mistakes in spelling. In fact it was quite easy to read his writing. For a further record of the case the reader is referred to the *Medical News* for August 1, 1896, p. 122.

In a summary of the results of a study of the symptoms in six cases of aphasia I have said, "The last three cases in the series published presented defects on the motor and emissive side of speech mechanism. The first of these three is the most interesting on account of the distinctness of the symptoms, the care with which they were observed, and the limited character of the lesion found at the time of the first operation. A detailed description of all the symptoms will be found by referring to the number of this journal in which the case has been published. Briefly stated, they were a loss of the power to spell or to arrange the letters in a word; loss of power to write intelligibly, because the letters were jumbled together in an irregular manner, but the letters of the alphabet were formed perfectly. In studying his spelling from day to day, it was observed that, while there was a certain similarity in the manner in which he arranged the letters in the words, he spelled the same word differently from time to time, thus showing an uncertainty in his own mind in regard to how a word should be spelled.

"Bastian¹ gives the copy of a letter written him by one of Sir William Jenner's patients while he (Bastian) was a resident physician in the University College Hospital in 1869. The recorder states that the handwriting was very good, and that the letter, which is a long one, contained only two trifling erasures. While there were several mistakes in spelling, the principal error consisted in the transposition and omission of words. Unfortunately, the case is not given in sufficient detail to enable one to determine whether the defect in writing is due to a lesion in the receptive (sensory) or emissive (motor) side of the speech mechanism.

"Kussmaul² quotes several cases from a paper written by Bastian. One of these was observed by Hughlings-Jackson. In it the misspelling was the most glaring speech defect. The patient in attempting to write her name wrote 'Sunnil, Siclaa, Satrena,' and for her address she wrote the following: 'Suners nut to mer tinn-lain.' In another case observed by Bastian the patient, trying to write 'Royal naval medical office belonging to the Admiralty,' wrote 'Roydnendd navendendd oforendendd Belondendd.' The patient observed by Ferber, an account of whose case is quoted by Kussmaul in this connection, wrote 'schrussen' for 'grüssen,' 'schreigen' for 'schreiben,' 'butter' for 'mutter,' 'omdern' for 'modern,' and in her own name put a 'g' in place of 'ch.'

"In none of the above quoted cases was the pathologic lesion determined by an autopsy or surgical operation, and Kussmaul fails

¹ Paralysis from Brain-Disease, pp. 189-190.

² Cyclopedia of the Practice of Medicine, Ziemssen, Vol. XIV, pp. 789-790.

to quote the clinical records of the cases to a sufficient extent to enable one to determine the probable seat of the lesion. The spelling, however, in most of the cases is similar to that found in the fourth case of the series. This case, so far as I know, is the first one placed on record in which a lesion limited to the foot of the second frontal convolution has been found, either at the autopsy or by a surgical operation for the relief of the brain symptoms, in which the speech defects have been observed and studied. The symptoms were carefully observed, and the primary defect in speech seemed to be an inability to arrange the letters in words in the order in which he had learned to place them. The man was intelligent, fairly well educated, and for years had held a responsible position that required him to be accurate in his spelling and writing. The defect in spelling led to his writing in an unintelligible manner. Besides the defect in spelling, there is an inability to arrange the words in a sentence according to grammatical usage, syntactic disturbances in speech or akataphasia. Syntactic defects in speech are found most typically in some cases of sensory aphasia. In the second case published in this series, the power to spell was perfect, but akataphasia was pronounced; one reason for concluding that the primary defect in speech in the third case reported was an inability to spell rather than an inability to write, and as shown by the patient's power to write readily and correctly on my spelling out the words for him.

"Loss of the power to spell correctly undoubtedly occurs in persons who are suffering from sensory aphasia, but these cases are easily distinguished from the cases of aphasia in which no visual or auditory disturbance of speech is found. It is probable that most cases of the loss of the power to spell due to a lesion in the foot of the second frontal convolution will be associated with some impairment of mind, the degree depending upon the character and extent of the lesion. Further observations are needed before we can determine whether these cases termed dislogical paraphasia can be distinguished from these forms of aphasia in which the defect in spelling is apparently the primary and principal symptom.¹

"If any conclusion is justifiable in the observation of one case, it would be that a lesion in the foot of the second frontal convolution

¹ In these cases, if the loss of power to write is due to the loss of the power to spell, is the word *agraphia* the proper term? It has occurred to me that the word *anorthographia* might be employed instead. Professor Maurice G. Dunham, Professor of Greek in the University of Colorado, for some very good reasons seems to prefer the term *scoliographia* instead of *anorthographia*. The principal objection which he makes to the latter term is the use of the "an" to denote negative. "An" is in common use before *arthria* to denote the negative.

on the left side in right-handed persons, and probably on the right side in left-handed individuals, will give rise to a defect in speech in which the principal symptom will be the loss of the power to spell.¹ It should be borne in mind that a lesion, such as a tumor, abscess, cyst, and probably thrombotic softening occurring in the foot of the second frontal convolution, will interfere to some extent with articulation, the mentality of the patient, and in many cases with the function of Broca's convolution. It is probable that the syntactic disturbances in speech depend upon the impaired mental condition of the patient. 'Unlike words, sentences are not stored up in memory ready for use.'²

"Does a centre for writing exist? According to Bastian and others, cases of *agraphia* have been observed in which the patient was unable to make more than meaningless strokes. These patients have been unable to read or spell correctly. We can write with a pen held with the teeth, hand, or foot. It is very improbable that the same centre in the cerebral cortex would serve to guide these various widely-separated groups of muscles in writing. On the other hand, no matter what groups of muscles we employ in the formation of letters, the arrangement of the letters in a given word is always the same. It seems to me more probable that the memory for the arrangement of letters in words is stored up in the cerebral cortex. This process is learned by tedious and repeated repetition. We should naturally expect to find the cortical centre in which is registered the memory pictures for the arrangement of letters in a word, to be located near the centre which governs the muscles usually employed in writing. It will be interesting to observe whether a lesion in the second frontal convolution on the right side of the brain in right-handed persons is attended with any loss of the power in spelling. So far as I can see at present, it is impossible to investigate the orthographic centre in a very illiterate person."

It seems to me that our studies of motor speech defects so far justify us in accepting the following conclusions:

The centre in which is stored the memory pictures of the arrangement of letters in words, etc., is probably situated in the foot of the left second frontal convolution in right-handed persons, and presumably in the corresponding convolution on the right side in left-handed individuals.

Cases of so-called pure motor *agraphia* apart from the involvement of the muscles concerned in writing have never been demonstrated, and reasoning from analogy it seems improbable for them to occur.

¹ It is possible that the primary defect is in the inability to pronounce.

² Kussmaul.

Oro-lingual paresis occurs from a lesion in the extreme lower portions of the central convolutions (ascending frontal and parietal). This centre is bilateral, and the paralysis is never complete from a unilateral lesion. The defect of speech from such a unilateral lesion is a dysarthria rather than an anarthria. It is distinguished from the disjointed articulation resulting from a lesion in the pons or medulla by the slight mental defect, by the symptoms of encroachment on Broca's centre, by the character of the paralysis, and the normal response of the affected muscles to the faradic current.

That Broca's aphasia is due to a lesion in the foot of the third frontal convolution I have not attempted to discuss, as the subject seems to be settled beyond all dispute.

Whether the loss of the power to write intelligibly, the letters of the alphabet still being formed perfectly, from the loss of the ability to spell or arrange letters in words according to usage, should be termed *agraphia* or *anorthographia* is questionable. I have met with one case in which the only defect connected with speech mechanism is the inability to pronounce. The patient writes a good hand voluntarily, and copies well and rapidly, transcribing both printing and writing into script. When I pronounce a word for him he spells it without hesitation, but he cannot pronounce such simple words as dog, cat, rat without showing some hesitancy and uncertainty. Longer words he cannot pronounce at all, or very rarely, and then only after a considerable effort. If I pronounce similar words for him he spells them readily. The lesion in this case was an old injury to the skull over the cortex, just in front of the face centre on the right side. To what extent the brain has been injured I am not able to say. The man has been insane twice, each time the insanity extending over a period of a year or more.

SENSORY APHASIA.

The various auditory and visual disturbances of speech are included in sensory aphasia.

Auditory Disturbances of Speech.—A case recently reported by me¹ seems to demonstrate that a lesion in the posterior portion of the first and second temporal convolutions will give rise to word-deafness and mind-deafness, and that the lesion necessary to produce mind-deafness must be more extensive than one capable of causing word-deafness.

A vigorous young man, a Bohemian by birth, in a drunken brawl, was struck above the left ear with a coupling-pin or the butt of a

¹ Mind and Word-Deafness, etc., Medical News, June 20, 1896, p. 698.

revolver and felled to the ground. The skull was fractured and a piece of bone detached and compressed the brain. The depressed bone was rectangular in shape, with long axis extending from before backward, and measuring in length two and a half inches and in width one and a quarter inches. The centre of the depressed bone was on the auriculo-bregmatic line. The lower portion of the fracture was a half inch above the base line of the skull. On Dr. Rogers removing the depressed portion of bone the patient regained a fair degree of consciousness after coming out from under the influence of the anesthetic, but he was found to be mind- and word-deaf. He could hear, as was evidenced by his looking in the direction from which sounds proceeded. He showed no gleam of intelligence when a watch was held to either ear, when a bell was tapped, or when coins or keys were jingled.

A few days later the patient had a general convulsion, which seemed to affect the trunk muscles more than those of the extremities. The next day another convulsion similar in character to the first occurred. The first and second temporal convolutions were explored, a small quantity of dark semifluid blood found just below the cortex and removed. Soon after the removal of the blood from the left temporal lobe, improvement became manifest, and within a few days he was able to distinguish sounds other than words. Then he showed distinct appreciation of the tick of a watch, or the jingling of coins or keys. When a watch was held against his ear he said, "Going pretty fast," but when I spoke to him he stared at me and seemed puzzled. The extravasated blood had taken place into the subcortical structure beneath the posterior portion of the first and second temporal convolutions. The patient made a complete recovery, and in the course of a few weeks from the time of the second operation all symptoms of word-deafness had passed away. It seems reasonable to conclude from a careful study of this case that the ability to interpret the meaning of sounds in general resides in about the same cortical area in which the memory pictures of the sounds of words are stored, but that the centre for psychical hearing is more extensive than that for word hearing, and a greater lesion is necessary to produce mind-deafness than word-deafness. It will be remembered that in the case just referred to mind-deafness began to lessen as soon as pressure caused by the hemorrhage had been relieved, although word-deafness did not improve a great deal until several days or a week or two later. It is just possible that the centre for the interpretation of sounds in general is situated posteriorly to the area in which word-memory resides.

Two forms of word-deafness are recognized by some. One is

termed pure word-deafness, and the only symptoms are inability to understand spoken speech and failure to write at dictation. The person so affected shows no defect in reading aloud, writing voluntarily, or copying or understanding what he has read or written. Professor Dejerine refers to a typical clinical case of this form of word-deafness observed by Sériex.¹ Dejerine thinks that the anatomical localization of pure word-deafness is not established, but is inclined to place it in the left temporal lobe. This form of word-deafness is probably due to a lesion in the left temporal lobe, and involves the auditory entering tracts from both hemispheres, as suggested by Lichtheim,² who observed a clinical case of pure word-deafness in which there was no disturbance in volitional speech and writing, nor in reading aloud. Starr has collected seven cases, most of which are examples of pure word-deafness, and in all of these the lesion was limited to the first and second left temporal convolutions.³

The second form of word-deafness is the sensory form of aphasia, described by Wernicke, in which there is not only loss of the power to understand spoken speech, with inability to write at dictation, but reading aloud is impaired or abolished. In these cases, as the patients cannot verify by audition what they say or mean to say, the centre for word-hearing, of course, being affected, paraphasia is present, including paraphagia and paralexia. It is questionable whether two forms of word-deafness should be recognized. In both the lesion is probably in the posterior two-thirds of the first and second temporal convolutions, but in pure word-deafness it is limited to the cortex in all probability, while in word-deafness with paraphasia it is more extensive, and the subcortical association tracts are undoubtedly affected.

While clinically we may distinguish three varieties of auditory disturbances of speech, pure word-deafness, mind-deafness, and word-deafness with paraphasia, the lesion in all these is in the posterior portion of the first and second left temporal convolutions in right-handed persons, and on the opposite side of the brain in left-handed individuals, being, in all probability, least extensive in the first variety and increasing in the order named, in the other two, in both of which it extends to the subcortical association tracts.

In all cases of auditory disturbance of speech, except the lightest pure word-deafness, there is some apraxia (loss of the knowledge of the use of things). This varies in proportion to the extent of the lesion in the posterior portions of the first and second temporal con-

¹ International Medical Magazine, August 18, 1895, p. 529.

² Quoted by Mills, A Text-Book on Nervous Diseases, by American Authors, p. 438.

³ M. Allen Starr, Brain, Vol. xii, 1889, p. 86.

volution. In some cases it is so slight as to be easily overlooked unless the patient is carefully examined for it. In some instances memory for the uses of the more common articles is retained, but it may be impaired for those that have been less frequently used by the patient. Apraxia has no localizing value except to indicate that the lesion is in the sensory or receptive side of speech mechanism. It is found in visual disturbances of speech when audition is unaffected, and *vice versa*.

If the auditory aphasiac is able to copy he will usually do so mechanically, transcribing printing into printing and writing into script, giving each letter the shading found in the original. The patient is often able to copy or write voluntarily his name, or some word with which he has become very familiar by having written it frequently in a routine way for a considerable length of time.

VISUAL DISTURBANCES OF SPEECH.

A brief abstract from the records of a case, reported by Dr. E. J. A. Rogers¹ and the writer, demonstrates the importance of the symptoms of the visual disturbances of speech as aids in cerebral localization. A young colored man, three months before I saw him, had been struck on the right forehead just above the supraorbital ridge with a chair wielded by another colored man. The patient was knocked down and rendered senseless for an hour or more. After regaining consciousness he felt dizzy and was troubled with slight headache for two or three days. Shortly after this occurrence he left the hospital and resumed his occupation as a waiter for eleven weeks. At the expiration of this time he was observed to be confused one morning, and later in the day he was found lying in the yard in a stuporous, semiconscious condition. When I saw him, two days later, a thrust of a pin into the right limbs or side of the body caused no movements, but the left leg or arm was withdrawn on being irritated. There was no paresis or paralysis of any muscles. The patient, although stupid and apparently delirious, would respond to questions, but his answers were irrelevant. When asked his name he said "beer." When asked if he had pain, he replied, "Mamma why don't you." By a series of questions, continued for nearly half an hour, it became evident from his answers that he recognized in a dazed manner what was said to him, but that he was aphasic and paraphasic. All forms of motor aphasia could be excluded, and as he was neither mind- nor word-deaf there seemed no auditory disturbance of speech. The natural conclusion was that the sensory aphasia was

¹ Medical News, June 6, 1896, p. 439.

of the visual type and the paraphasia resulted from an extensive sub-cortical lesion, below the angular gyrus. On Dr. E. J. A. Rogers removing a button of bone from the posterior portion of the parietal region, a few lines below the parietal eminence, and exploring the brain, a considerable quantity of dark clotted blood and softened brain tissue was found in the centrum ovale at some depths below the cortex of the angular gyrus. The patient made a tedious but complete recovery.

During convalescence from the surgical operation he was repeatedly examined with reference to his speech defect. There was a condition of partial apraxia for memories of all the special senses, except tactile, but for those of this sense the apraxia was complete on the right side and partial on the left. His failure to recall the spoken names of objects was about as great as his inability to recall the uses of things. He understood speech and sounds other than speech perfectly. He had never known anything of music, and it was therefore impossible to determine the effect of the lesion on this sense. He experienced little difficulty in calling to mind objects named, and readily pointed them out at request. No auditory defect of speech was found.

He could not recognize letters, figures, notes, and colors seen. He did not understand printed or written words. He could not read printing, writing, or music aloud or inaudibly, neither could he recall objects the names of which were seen. On testing his power to write voluntarily, he wrote,—

“Willeer Dotson

E J illul bag and Jack.”

Meaning to write William Dotson (his name), but the other is meaningless. It is probable, however, that he intended it for his address.

On dictating for him to write “The people enjoyed themselves,” he wrote “The peole enjoujm evfoves themseds.”

On trying to copy “James come home,” he wrote “fues Cues Cues.” I neglected to test his ability to copy printing.

After he had learned to recognize and name “bell,” “spoon,” and “lamp,” he was requested to write their names. For “bell” he wrote “Hell,” for “spoon,” “spoodn,” and for “lamp,” “lampus.”

He could write his name imperfectly, and was able to read it immediately after writing it, but the next day he failed to decipher it. He could not read his name when it was written by another person, nor when it was printed. Occasionally he could recognize a letter when he was made to trace it with the index finger, the movements being guided by another person. The patient had right bilateral

hemianopsia, and this condition remained for nearly two months after the operation.

Two forms of word-blindness are described by Dejerine.¹ The ordinary form is the one presented by the patient to whose case reference has just been made. The patient is usually completely or partially agraphic, paraphasic, and alexic. This condition is due to a lesion in the cortex of the left angular gyrus. It is probable that the paraphasia found in most of these cases is caused by the destruction of the association fibres beneath the angular gyrus. When the lesion is deep and involves the optic radiations on their way to the cuneus, right bilateral homonymous hemianopsia will also be present. The patient is usually unable to recognize words or letters, but he may or may not be able to read figures or to calculate.

The second form of word-blindness has been described by Dejerine and termed *pure word-blindness*. The patient writes spontaneously and at dictation, as in the normal condition, naturally without being able to read it; but a copy is altered and made mechanically. Speech and intelligence are intact. In a case observed by Dejerine, the lesion was found at the autopsy to involve the point of the occipital lobe, the base of the cuneus, and the lingual and fusiform lobules. The patient, very intelligent and cultivated, was totally word-blind and hemianopsic, but he could write spontaneously and at dictation. He was also note-blind. Formerly a good musician, he could not decipher a single note. He could read figures and calculate, and speech and intelligence were intact.

Wyllie and Redlich, according to Dejerine, have reported similar cases which presented the same anatomical localization. Cases XLII, XLIII, and XLIV in the table compiled by Starr² bear some resemblance to the case reported by Dejerine, but none of these are typical.

Mind-blindness, inability to determine an object by the visual organs, is a condition somewhat similar to apraxia, in which the subject has lost the power to recall the use of an object. Such a defect is due to a lesion in the occipital lobe, situated in the cortex or deep in the white substance involving the association fibres which connect the occipital cortical centres of sight with other regions of the brain. In the fifty cases of sensory aphasia collected by Starr, twelve presented a condition of psychological blindness, and in all the occipital lobe was diseased. In six of the twelve cases hemianopsia was also present.³

¹ International Medical Magazine, August, 1895, p. 528.

² Brain, Vol. XII, 1889, p. 100.

³ Ibid.

Not infrequently word-deafness and word-blindness with various disturbances of speech occur from extensive cortical or subcortical lesions ; so that while word-blindness is produced by a lesion in the cortex of the angular gyrus, it may also occur, as Starr has pointed out, from one extending from this centre, either anteriorly into the temporal region or posteriorly into the occipital. In the former instance it would probably be associated with word-deafness, and in the latter with mind-blindness.

"In testing the temporo-occipital association tracts inability to distinguish a familiar object by its sound would indicate that the temporal end is affected ; failure to recognize an object seen, a break in the occipital end ; and loss of power to recall the name of an object recognized, a lesion in the course of the tracts between the temporal and occipital lobes."¹

Professor Dejerine claims to be among the first, if not the first, to call attention to the fact that in some cases of word-blindness there occurs a defect of speech similar to that found from a lesion in Broca's convolution. Of twenty-seven cases tabulated by Starr in which word-blindness and word-deafness existed, a motor defect of speech was observed in only two.

This article might be indefinitely extended in the discussion of interesting symptoms of speech-defect, but the principal ones of value as aids in making a localizing diagnosis have been presented. These may be briefly summarized.

(1) If the lesion is in the foot of the left third frontal, Broca's, convolution in right-handed persons, and in the corresponding portion of the brain on the opposite side in left-handed individuals, the patient will be unable to speak voluntarily, to repeat words after another, to read aloud, to think in speech, and in the majority of cases to write voluntarily or from dictation so as to be understood, but he can understand the speech of another. He usually will be able to use and understand gesture expression.

(2) A lesion in the oro-lingual centre (lower portion of the central convolutions) will cause paresis or paralysis of the oro-lingual muscles, including the lower side of the face, and imperfect articulation, but the patient will be able, with a decided effort, to repeat words after another, to talk voluntarily, to think in speech, and to write, although the letters may be imperfectly formed. There is, as a rule, no omission or transposition of letters or word unless the lesion is sufficiently extensive to affect the adjacent cortical centres or their commissural fibres. It is possible that this centre is bilateral ; that a lesion on either side may give rise to somewhat similar symptoms, and that the

¹ Ibid.

loss of function in the affected muscles will not be completely abolished from a unilateral lesion.

(3) A lesion in the foot of the second frontal convolution on the left side in right-handed persons or on the right side in left-handed individuals (the probable orthographic centre) will be attended by disturbances in writing, consisting of inability to write from inability to spell. In the only case reported of this character the patient formed all the letters of the alphabet perfectly, but he omitted, transposed, and substituted letters to such an extent that his writing was unintelligible. He wrote well if the words were spelled for him.

(4) A limited lesion in the posterior two-thirds of the first and second temporal convolutions will be attended by word-deafness, and inability to write at dictation pure word-deafness. In a more extensive lesion in this region, mind-deafness with paraphasia and some disturbances in reading and writing will be added. The greater the extent of the cortical and subcortical areas involved the more marked the paraphasia and other symptoms of sensory aphasia.

(5) A lesion involving the angular gyrus and adjacent parts will cause word-blindness and inability to read, defects in writing, copying, and in speaking. In these cases paraphasia is often present. If the lesion affects the parts posterior to the angular gyrus, mind-blindness may be added.

The following is the plan that I have been in the habit of adopting in investigating cases of aphasia:¹

(1) The power to recognize objects seen, heard, felt, tasted, smelled, and their uses.

(2) The power to recall the spoken names of objects seen, heard, felt, tasted, and smelled.

(3) The power to understand sounds other than speech.

(4) The power to understand speech and music.

(5) The power to call to mind objects named and point them out at request.

(6) If word-deaf, can he recognize his own name when it is spoken?

(7) The power to recognize a word spelled aloud.²

(8) The power to call up mentally the sound of a note, figure, letter, or word.

¹ Developed from the plan first suggested by Starr.

² Since writing the above I have added at this point (1) the power to pronounce inaudibly or aloud on hearing the word spelled; (2) the power to spell a word inaudibly or aloud on hearing it pronounced.

The examination thus far will test the various sensory areas, but more especially the auditory and the association tracts between the different sensory areas connected with speech.

(9) The power to recognize letters, figures, notes, and colors seen.

(10) The power to understand printed and written words.

(11) The power to read printing, writing, and music aloud and inaudibly, and to understand what he reads.

(12) The power to recall objects the names of which are seen.

(13) The power to write voluntarily.

(14) The power to write at dictation.

(15) The power to copy and the manner of copying printing and writing.

(16) The power to write the names of objects seen, heard, felt, tasted, and smelled.

(17) The power to read aloud and inaudibly and to understand what has been written.

(18) The power to write his name and the ability to read it when written by himself or by another person or when printed.

(19) The power to recognize a letter by tracing it with the index-finger or with a pencil, the movements being guided by another.

(20) The power to call up mentally the appearance of an object, a figure, note, letter, or word, when word-blind.

These additional tests will aid in determining the condition of the visual word memories in the angular gyrus and the connection between this area and the surrounding sensory and motor areas.

(21) The power to speak voluntarily, and, if impaired or lost, the character of the defect.

(22) The power to repeat words after another.

(23) Does the patient recognize his mistakes in speaking and writing, and can he correct them?

(24) Can the patient think in speech (propositionize)?

(25) Is there any special difficulty in the use of nouns, verbs, or other parts of speech?

(26) The power to understand pantomime or gesture expression.

(27) The power to employ intelligently gesture in expression.

(28) The power to read figures and to calculate.

(29) The power to count, both money and in numbers.

(30) The power to play a game of cards or other games.¹

¹ In the preparation of this paper I have extracted freely from the article on "Cerebral Localization" recently written by me for The American System of Medicine.

